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## Abstract

This thesis investigates the loss of high mass ions due to their initial thermal energy in ion trap mass analyzers. It provides an analytical expression for estimating the percentage loss of ions of a given mass at a particular temperature, in a trap operating with a set of conditions. The investigations have been carried out on quadrupole and cylindrical ion trap geometries.

The three-dimensional Maxwellian velocity distribution function has been assumed to derive an expression for the percentage of ions lost. Adopting an approximation based on the observed escape velocity profiles of ions, an expression for the percentage loss of ions of a given mass has been derived as a function of the temperature for an ensemble of ions, its mass and its escape velocity. An analytical expression for the escape velocity has also been developed. It is seen that the escape velocity is a function of the trapping field, drive frequency and ion mass. Because the trapping field is determined by trap design parameters and operating conditions, it has been possible to study the influence of these parameters on ion loss. The parameters investigated include ion temperature, magnitude of the initial potential applied to the ring electrode (which determines the low mass cut-off), trap size, dimensions of apertures in the endcap electrodes and RF drive frequency.

The studies demonstrate that ion loss due to initial thermal energy increases with increase in mass and that ion escape occurs in the radial direction. Reduction in the loss of high mass ions is favoured by lower ion temperatures, increasing low mass cut-off, increasing trap size, and higher RF drive frequencies. The dimensions of the apertures in the endcap electrodes do not influence ion loss in the range of aperture sizes considered.